

M e m o r a n d u m

To: Paul H. Gosselin, Assistant Director
Division of Enforcement, Environmental
Monitoring, and Data Management

Date: **July 18, 1997**

From: **Department of Pesticide Regulation - 1020 N Street, Room 161**
Sacramento, California 958 14-5624

Subject: **MONITORING METHYL BROMIDE FIELD FUMIGATIONS
DURING WINTER MONTHS**

EXECUTIVE SUMMARY

Purpose

The Department of Pesticide Regulation (DPR) conducted this study to determine the effectiveness of buffer zones for methyl bromide applications under winter climatic conditions. Higher air concentrations may occur during winter months due to more stable atmospheric conditions. Hence, methyl bromide buffer zones may need to be adjusted during winter months. To determine the effectiveness of the buffer zones, air concentrations were monitored for four different application methods between December 1996 and February 1997. Each method was monitored one time while a previously unmonitored method was monitored on three occasions.

DPR and the county agricultural commissioners implemented permit conditions, including buffer zones, to mitigate unacceptable methyl bromide exposure. DPR relied upon monitoring data and computer modeling to determine the buffer zone distances. Monitoring to validate the size of the buffer zones was done in the summer months. DPR felt that summer months represented worst-case conditions since more methyl bromide would be emitted in warmer weather because the emissions are governed by adsorption and diffusion through soil. However, concerns about the effect of wintertime weather stability prompted DPR to evaluate these applications.

Study Methods

Between December 1996 and February 1997 air concentrations of methyl bromide were monitored for four different application methods: 1) hot-gas, 2) tarpaulin-bed, 3) very-high-barrier tarpaulin, and 4) shallow tarpaulin. Air samplers were placed at eight sites surrounding each application--one sampler at each corner, and one at the center of each side of the application. The samplers at the perimeter of the application were placed at the buffer zone distance specified by the permit conditions. Air sampling was initiated at the start of the application and continued for 24 - 48 hours.

Results

Air concentrations of methyl bromide exceeded target exposure value [0.21 parts per million (ppm) 24-hour time-weighted average] at the perimeter of the buffer zone in four out of six applications. The highest concentrations were detected for the hot-gas application; two of the three hot-gas applications exceeded the target concentration at the buffer zone. Staff observed problems with the first application such as leaking manifolds. The application may have been conducted inconsistent with appropriate procedures. The other two applications which exceeded target concentrations involved the tarp-bed and very-high-barrier tarp applications. Air concentrations of methyl bromide were within the target exposure value from the shallow tarpaulin application. Weather data taken at the time of the applications confirmed that monitoring occurred during periods of stable weather.

Conclusions

The study demonstrated that weather stability during winter months increases methyl bromide concentrations. The study revealed higher concentrations for hot-gas, tarp-bed and very-high-barrier tarp applications than expected. The results for the tarp-bed and very-high-barrier tarp conflicted with results during summer conditions.

Paul H. Gosselin

July 18, 1997

Page 3

The study highlighted that DPR needs to continue to evaluate management practices implemented to reduce the public's exposure to methyl bromide. DPR will evaluate and implement mitigation measures based on the results of this study.

A complete description of the monitoring is attached.

A handwritten signature in black ink, reading "John S. Sanders". The signature is written in a cursive style with a large, stylized "J" and "S".

John S. Sanders, Ph.D., Chief
Environmental Monitoring and
Pest Management Branch
(916) 324-4100

Attachment

MONITORING METHYL BROMIDE FIELD FUMIGATIONS DURING WINTER MONTHS

Background

Beginning in 1993, the Department of Pesticide Regulation (DPR) and the county agricultural commissioners implemented permit conditions, including buffer zones, to mitigate unacceptable methyl bromide exposure. DPR relied on computer modeling and monitoring data to determine the buffer zone distances. The size of the calculated buffer zones was subsequently validated using field monitoring data. This monitoring was done in the summer months, which DPR felt represented worst-case conditions. More methyl bromide is emitted in warmer weather because emissions are governed by adsorption and diffusion through soil. However, concerns about the effect of winter weather stability on methyl bromide concentrations in air prompted DPR to evaluate the effectiveness of buffer zones under winter climatic conditions. Higher air concentrations may occur during winter months due to more stable atmospheric conditions. This would require adjustments of methyl bromide buffer zones during winter months.

General Description of Materials and Methods

Four different application methods were monitored: three hot-gas applications (method 12 in permit conditions), one tarpaulin-bed application (method 10), one very-high-barrier tarpaulin application (method 8.1), and one shallow tarpaulin application (method 5). The hot-gas method had not been monitored previously, but the application equipment and procedures were similar to greenhouse applications. For hot-gas applications, tarpaulins were secured over preformed beds; the furrows were left untarped. The methyl bromide was heated, passed through a manifold and injected into the beds through drip irrigation lines. The other three application methods inject methyl bromide beneath the soil through shanks attached to a tractor. The same tractor or a second tractor covers the fumigated area with a tarpaulin. Application rates ranged from 200 to 350 pounds per acre. Field size ranged from 14 to 25 acres (Table 1). Detailed descriptions of the application for each field are described in individual sections.

Monitoring was conducted by placing air samplers (SKC #224-PCXR8) with activated charcoal tubes (SKC #226-38-02) at eight sites surrounding each application, one sampler at each corner and one sampler at the center of each side of the application. The eight samplers were placed at the resident buffer zone distance. Additional samplers were placed 30 feet from each side of the field, unless 30 feet was the resident buffer zone distance. Sampling was initiated at the start of the application and continued for 24 - 48 hours, with each sampling interval 6 - 12 hours. The air flow rate for all samplers was calibrated to 15 milliliters per minute. Wind speed, wind direction, air temperature, and relative humidity were recorded every five minutes with a Met-1@ meteorological station. Detailed descriptions of the sampling methods for each field are described in individual sections. The California Department of Food and Agriculture's Center for Analytical Chemistry conducted the laboratory analyses. The samples were extracted with ethyl acetate and analyzed using a gas chromatograph with an electron capture detector.

General Description of Results

Off-site air concentrations exceeded DPR's target level of 0.21 ppm (24-hour time-weighted average) at the resident buffer zone distance for three of the four methods monitored (Table 1). Downwind air concentrations ranged from 0.082 to approximately 1 part per million (24-hour time-weighted average) at the buffer zone distance. The highest concentrations were detected for Field 1 (Table 1), a hot-gas application (method 12 in permit conditions). This application method had not been monitored previously.² Two additional fumigations monitored for this application method showed lower concentrations (Fields 3 and 4, Table 1), but the target level was still exceeded at the original buffer zone distance on one of these applications (Field 4, Table 1); two of the three hot-gas applications exceeded the target concentration at the original buffer zone distances. Detailed descriptions of the results for each field are described in individual sections.

²After the results for Field 1 were received, the permit conditions for hot-gas applications were revised. The revisions include buffer zones more than four times larger than specified in the original permit conditions.

For the remaining three applications monitored, two had air concentrations above the target level at the buffer zone distance (Fields 2 and 5, Table 1). For all applications, the highest concentrations were detected in the predominant downwind direction and concentrations decreased with distance from the field.

As expected, monitoring occurred during periods of stable weather (Table 2). Weather conditions were stable and calm for at least ten hours per day during all six applications monitored. Wind speeds were low, usually less than 5 miles per hour. Daily high air temperatures were 63 - 78 degrees Fahrenheit.

For quality control, the laboratory prepared and analyzed charcoal tubes containing a known amount of methyl bromide (spiked samples) with each set of field samples submitted. The recoveries from 59 spiked samples averaged 76 percent. A trapping efficiency test was also conducted in which tubes containing glass wool were spiked with methyl bromide and connected to air samplers. The recoveries from these six samples averaged 93 percent. The field sampling results were not adjusted for these recoveries because the quality control tests may not be indicative of the true recovery. The spikes were created by adding methyl bromide dissolved in a solvent to the quality control samples. Results of samples containing methyl bromide in liquid form may not indicate the method performance for samples containing methyl bromide in gaseous form.

Detailed descriptions of each field follows.

Table 1. Methyl bromide off-site monitoring during winter months.

Field	Date Applied	County	Applic Rate (lb/ac)	A c r e s	Perrnit Condition Application Method	Highest Measured 24-hour Conc at Buffer (ppm)
1	12/11/96	Riverside	200	25	12-hot gas	~1 ¹
2	12/12/96	Riverside	200	19	lo-tarp bed	0.57
3	1/20/97	Kern	200	14	12-hot gas	0.16
4	1/27/97	Imperial	200	14	12-hot gas	0.55
5	2/6/97	Madera	350	19	8.1-very high barrier	0.99
6	2/13/97	San Luis Obispo	200	10	5-shallow tarp	0.082

¹ Concentration estimated because samplers were not located at the buffer zone distance

Table 2. Weather conditions during the monitored applications

Field	Temp Range (°F)	Wind Speed Range (mph)
1	60 - 76	0 - 6.7
2	60 - 78	2.2 - 6.9
3	58 - 66	0 - 10.7
4	49 - 75	0 - 8.9
5	41 - 63	0 - 11.1
6	37 - 74	0 - 10.3

Materials and Methods for Field 1 — The first field monitored was treated by a hot-gas application to a 25-acre field near Indio (Riverside County) on December 11, 1996. A hot-gas application is similar to a greenhouse or structural fumigation, where the area to be fumigated is first enclosed with a tarpaulin. In this case, tarpaulins were secured over pre-formed beds; the furrows were left untarped. The methyl bromide is then heated, passed through a manifold and injected into the beds through drip irrigation lines. The specific equipment for this application had a manifold that allowed 12 beds to be fumigated at one time. The drip irrigation lines were two to six inches below the top of the bed. The field was to be planted with cantaloupes. The application rate was 220 pounds per acre of formulated product, 98 percent methyl bromide/2 percent chloropicrin (planned application rate was 200 pounds per acre). The application took approximately eight hours to complete. The area treated was part of an 80-acre field and adjacent blocks were treated the day before and the day after monitoring.

Ambient air samples were collected at 12 locations using charcoal tubes and SKC air samplers. Eight samplers were located at the expected resident buffer zone distance, one at each corner and one at the middle of each side. Four other samplers were located 30 feet from the middle of each side. Samplers were set up assuming that 20 acres would be fumigated. Instead, 25 acres were treated and the locations of the samplers relative to the field edge changed; samplers were not located at the buffer zone distance. Table 4 and Figure 1 indicate the position of each sampler. A series of two samples was collected at each of the 12 locations beginning with start of fumigation at 07:00. The first set sampled for the first 11 hours and the second set for the next 13 hours, for a total of 24 hours.

Results for Field 1 — Due to late changes in the application, samplers were not located at the resident buffer zone distance. However, the calculations indicate that DPR's target level of 0.21 parts per million was probably exceeded outside the buffer zone (550 feet). The 24-hour time-weighted average concentration measured 330 feet downwind was 1.7 parts per million (Table 3, Figure 1). This concentration is approximately five times higher than the expected level at this distance.

Weather during the monitoring period was calm and warm. The air temperature ranged from 60 to 76 degrees Fahrenheit. Wind speeds were less than 4 miles per hour 76 percent of the time.

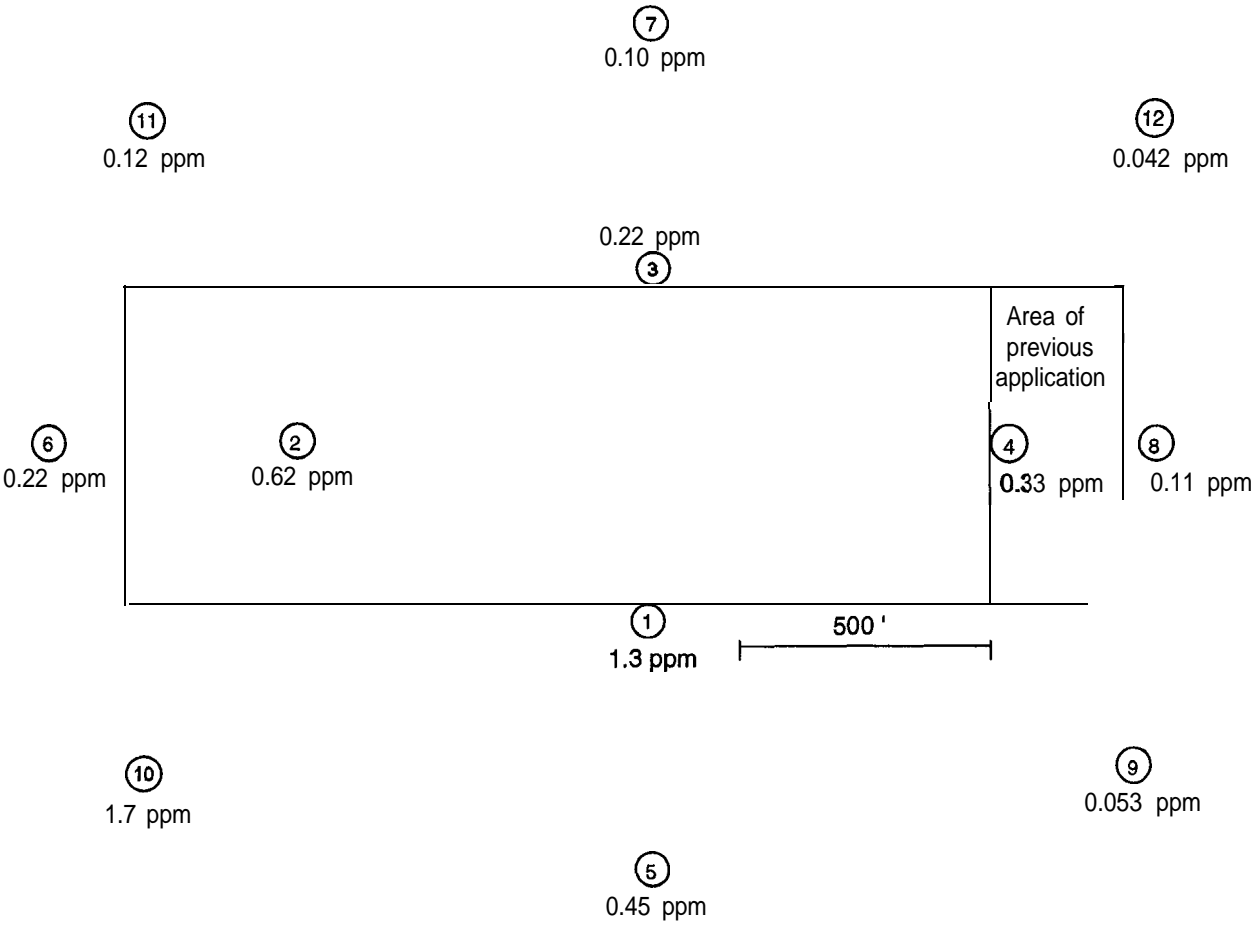
Table 3. Ambient methyl bromide air concentrations during winter months, Field 1, hot-gas application.

Sampler Location				Methyl Bromide (ppm) for Each Sampling Period	
				07:00 - 18:00 (11 hours)	18:00 - 07:00 (13 hours)
Site ID	Direction	Distance			
1	south	30		0.84	1.8
2	west	-345 ^a		0.45	0.79
3	north	30		0.29	0.15
4	east	30 ^b		0.51	0.16
5	south	530		0.059	0.84
6	west	155		0.17	0.26
7	north	530		0.041	0.16
8	east	324 ^b		0.11	0.11
9	southeast	431		0.028	0.079
10	southwest	330		1.3	2.0
11	northwest	330		0.13	0.11
12	northeast	467		0.020	0.064

^a This sampler located 345 feet inside the treated area. Sampler was originally planned to be 30 feet outside, but additional acres were treated.

^b These samplers located inside the area treated the day before

Figure 1. Application site and first 24-hour time-weighted average concentrations at each sampler location for Field 1 - hot gas application.



Materials and Methods for Field 2 — The second field monitored was a 19-acre field near Indio (Riverside County) treated with methyl bromide by a tarped bed application method on December 12, 1996. A tarped bed application is similar to a shallow tarped broadcast fumigation, where the area to be fumigated is disced and uncovered before application. In this case, tarpaulins were secured over beds formed immediately following injection of methyl bromide; the furrows were left untarped. The methyl bromide was injected into the soil through tractor-mounted shanks at a depth of 12 - 14 inches. The specific equipment for this application method formed the beds and fumigated in one operation. With each pass the tractor formed 3 beds with three injectors for each bed--set 5 inches apart. A second tractor followed immediately behind laying down the high barrier tarpaulin. The application rate was 195 pounds per acre of formulated product, 98 percent methyl bromide/2 percent chloropicrin (planned application rate was 200 pounds per acre). The application took approximately six hours to complete. The area treated was part of a 40-acre field and the second half of the field was treated the day after monitoring.

Ambient air samples were collected at 12 locations using charcoal tubes and SKC air samplers. Eight samplers were located at the expected resident buffer zone distance, one at each corner and one at the middle of each side. Four other samplers were located 30 feet from the middle of each side. Samplers were set up assuming that 18 acres would be fumigated requiring a 430 feet residential buffer zone, instead 19 acres were treated. Table 5 and Figure 2 indicate the position of each sampler. A series of two samples was collected at each of the 12 locations beginning with start of fumigation at 10:00. Samples were collected during two 12-hour sampling periods, for a total of 24 hours.

Results for Field 2 — Due to late changes in the application, some samplers were not located at the resident buffer zone distance. However, our calculations indicate that DPR's target level of 0.21 parts per million was probably exceeded outside the 430 feet buffer zone. The 24-hour time-weighted average concentration measured 405 feet downwind was 0.57 parts per million (Table 4, Figure 2).

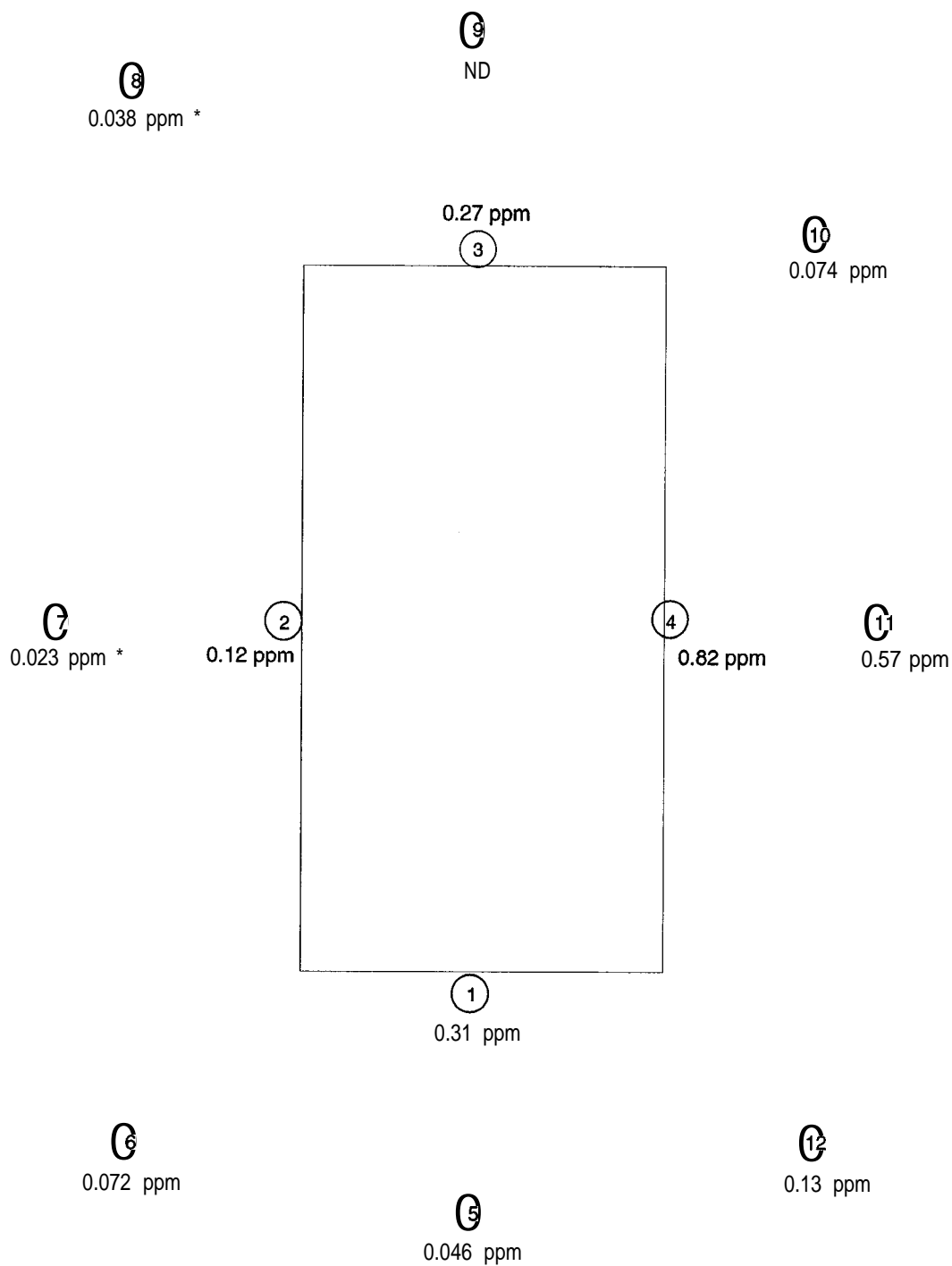
During the monitoring periods, the skies were clear and the wind speed and air temperature ranged from 2.2 to 6.9 miles per hour and 60 to 78 degrees Fahrenheit, respectively. The wind speed was measured at 4.4 to 6.7 miles per hour for 79 percent of the monitoring period.

Table 4. Ambient methyl bromide air concentrations during winter conditions, Field 2, tarped bed application.

Sampler Location				Methyl Bromide (ppm) for Each Sampling Period	
				10:00 - 22:00 (12 hrs)	22:00 - 10:00 (12 hrs)
Site ID	Direction	Distance (ft)			
1	south	30		0.39	0.23
2	west	30		0.24	0.0050
3	north	30		0.52	0.029
4	east	5		0.65	1.0
5	south	430		0.028	0.065
6	southwest	430		0.072	0.074
7	west	430		0.042	ND
8	northwest	430		0.072	ND
9	north	430		ND ^a	ND
10	northeast	288		0.13	0.021
11	east	405		0.46	0.69
12	southeast	408		0.089	0.17

^aNo detectable amount, reporting limit = 0.005 ppm

Figure 2. Application site and first 24-hour time-weighted average concentrations at each sampler location, Field 2, tarped bed application. (*indicates one of the periods had no detectable amount, $\frac{1}{2}$ the detection limit was used to calculate the 24-hour average)



Materials and Methods for Field 3 — The third field monitored during the study was a 13.6-acre field near Arvin (Kern County) treated by the hot-gas method on January 20, 1997. A hot-gas application is similar to a greenhouse or structural fumigation, where the area to be fumigated is first enclosed with a tarpaulin. In this case, tarpaulins were secured over pre-formed beds; the furrows were left untarped. The methyl bromide is then heated, passed through a manifold and injected into the beds through drip irrigation lines. The specific equipment for this application had a manifold that allowed 12 beds to be fumigated at one time. The equipment was set up on an access road that ran through the middle of the application area, and application was made to the beds south of the road then the north set was treated. The equipment was moved west and set up for the next set of beds. The drip irrigation lines were two to six inches below the top of the bed. The field had loamy sandy soil and was to be planted with peppers. The 68 inch beds were covered with black 1.25 mil tarpaulin. The application rate was 220 pounds per acre of formulated product, 98 percent methyl bromide/2 percent chloropicrin (planned application rate was 200 pounds per acre of methyl bromide). The application took approximately six hours to complete.

Ambient air samples were collected at 12 locations using charcoal tubes and SKC air samplers. Eight samplers were located at the resident buffer zone distance of 360 feet, one at each corner and one at the middle of each side. Four other samplers were located 30 feet from the middle of each side. Table 6 and Figure 3 indicate the position of each sampler. A series of five samples was collected at each of the 12 locations beginning with start of fumigation at 10:00. The first six-hour sampling period encompassed the application period which ended at 16:00. Monitoring continued through an additional 6-hour period and three 12-hour periods, for a total of 48 hours.

Results for Field 3 — Ambient methyl bromide 24-hour time-weighted average concentrations at the buffer zone distance ranged from 0.008 ppm to 0.165 ppm (Table 5, Figure 3). DPR's target level of 0.21 ppm was not exceeded at the 360 feet buffer zone during the application or the 24 hours following application.

During the monitoring period the skies were thin overcast with thicker overcast conditions during the last monitoring period. Wind speeds ranged from 0.8 to 10.7 miles per hour.

Table 5. Ambient methyl bromide air concentrations during winter months, Field 3, hot-gas application.

Sampler Location			Methyl Bromide (ppm) for each Sampling Period				
			10:00-16:00 ID	16:00-22:00 (6 hours)	22:00-10:00 (12 hours)	10:00-22:00 (12 hours)	22:00-10:00 (12 hours)
Site Direction	Distance (feet)						
1 south	30		0.24	0.28	0.08	0.11	0.035
2 west	30		ND ^a	0.48	0.51 ^{*4}	0.083	0.13
3 north	30		ND	0.16	0.22	0.043	0.17 ^{*5}
4 east	30		0.32	ND	0.034	0.023	0.014 ^{*6}
5 south	360		0.058	0.087	0.007	0.022	ND
6 southwest	360		ND	0.13	0.019	0.0072	0.016
7 west	360		ND	0.22	0.22	0.021	0.070
8 northwest	360		ND	0.16	0.16	0.018	0.064
9 north	360		ND	ND	0.060	0.0054	0.040
10 northeast	360		ND ^{*1}	ND	0.015	ND ^b	0.0089
11 east	360		0.019 ^{*2}	ND ^{*3}	0.0077	ND	ND
12 southeast	360		0.059	ND	0.005 1	ND	ND

ND = no detectable amount;

^a reporting limit is 0.01 parts per million

^b reporting limit is 0.005 parts per million

* = Sampler turned off early;

¹ sampler ran 4.1 hours

² sampler ran 4.5 hours

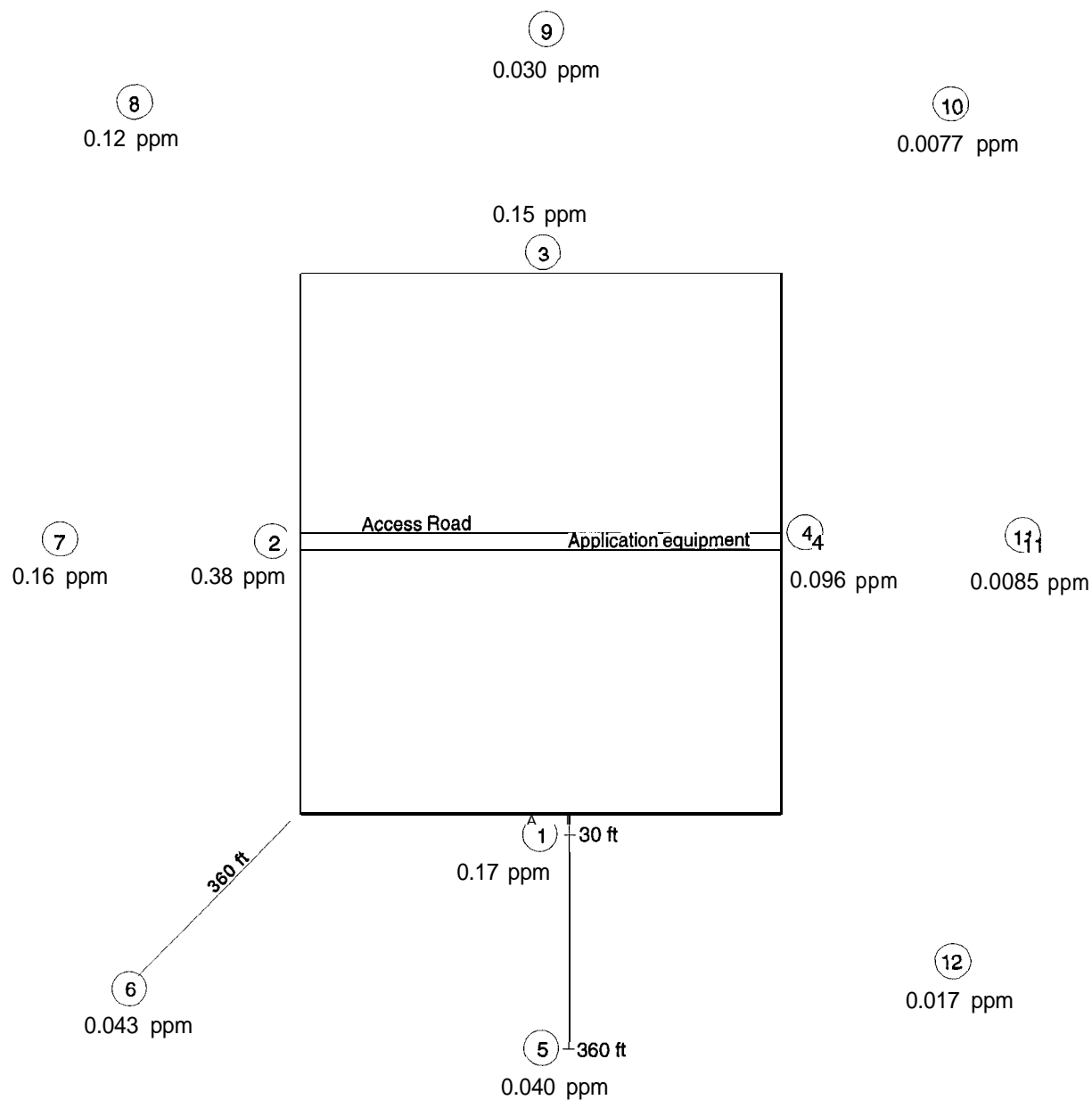
³ sampler ran 3.2 hours

⁴ sampler ran 9.6 hours

⁵ sampler ran 4.2 hours

⁶ sampler ran 8.1 hours

Figure 3. Application site and first 24-hour time-weighted average concentrations at each sampler location, Field 3, hot-gas application.



Materials and Methods for Field 4 — The fourth field monitored was a 14-acre field near El Centro (Imperial County) treated by the hot-gas method on January 27, 1997. A hot-gas application is similar to a greenhouse or structural fumigation, where the area to be fumigated is first enclosed with a tarpaulin. In this case, tarpaulins were secured over pre-formed beds; the furrows were left untarped. The methyl bromide is then heated, passed through a manifold and injected into the beds through drip irrigation lines. The specific equipment for this application had a manifold that allowed 10 beds to be fumigated at one time. The equipment was set up on an access road on the southwest corner of the field. The application continued north along the road. The drip irrigation lines were two to six inches below the top of the bed. The field had loamy sandy soil and was to be planted with peppers. The 68 inch beds were covered with clear 1.5 mil tarpaulin. The application rate was 200 pounds per acre of formulated product, 98 percent methyl bromide/2 percent chloropicrin. The application took approximately six hours to complete.

Ambient air samples were collected at 12 locations using charcoal tubes and SKC air samplers. Eight samplers were located at the resident buffer zone distance of 360 feet, one at each corner and one at the middle of each side. Four other samplers were located 30 feet from the middle of each side. Table 7 and Figure 4 indicate the position of each sampler. A series of three sampling periods were monitored at each of the 12 locations beginning with start of fumigation at 10:00. The first 6-hour sampling period encompassed the application period which ended at 16:00. Monitoring continued through an additional 6-hour period and one 12-hour periods, for a total of 24 hours.

Results for Field 4 — Ambient methyl bromide 24-hour time-weighted average concentrations at the buffer zone distance ranged from 0.072 ppm to 0.55 ppm (Table 6, Figure 4). DPR's target level of 0.21 ppm was exceeded at the buffer zone distance (360 feet) during the first 24 hours of the application.

The air temperature during the monitoring period ranged from 49 to 75 degrees Fahrenheit with thin overcast skies. The wind speeds ranged from 0 to 8.9 miles per hour, and 71 percent of the time was measured at 0.75 to 2 miles per hour.

Table 6. Ambient methyl bromide air concentrations during winter months, Field 4, hot-gas application.

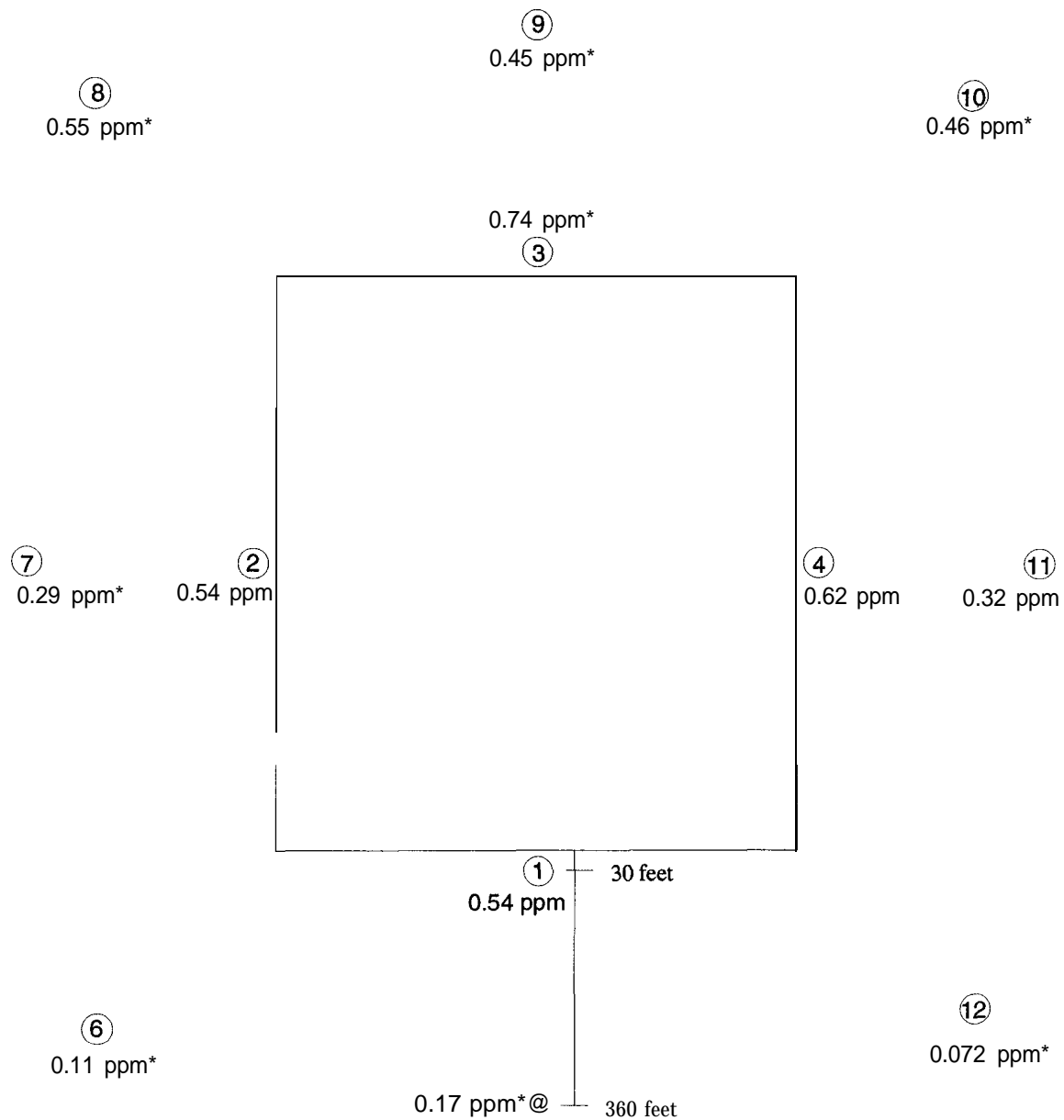
Sampler Location			Methyl Bromide (ppm) for Each Sampling Period		
			10:00 - 16:00 (6 hours)	16:00 - 22:00 (6 hours)	22:00 - 10:00 (12 hours)
Site ID	Direction	Distance (ft)			
1	south	30	0.18	1.9	0.039
2	west	30	0.019	0.74	0.69
3	north	30	ND ^a	0.59	1.5
4	east	30	0.21	0.87	0.70
5	south	360	0.034	0.62	ND ^b
6	southwest	360	ND	0.42	ND
7	west	360	ND	0.76	0.19
8	northwest	360	ND	0.35	0.92
9	north	360	ND	0.30	0.75
10	northeast	360	ND	0.49	0.68
11	east	360	0.012	0.21	0.52
12	southeast	360	0.028	0.26	ND

ND = no detectable amount;

^a reporting limit = 0.010 parts per million

^b reporting limit = 0.005 parts per million

Figure 4. The application site, sampling sites and highest 24-hour time-weighted averages, Field 4, Day 2, hot-gas application. (*indicates a period of no detectable amount where $\frac{1}{2}$ the detection limit was used).



Materials and Methods for Field 5 — The fifth field monitored during the study was a 19-acre field near Madera (Madera County) treated by a tarped shallow injection application on February 6 and 7, 1997. This method of application involves the injection of methyl bromide into the soil at a depth between 10 and 15 inches deep and simultaneous coverage with tarp. In this case, the tarpaulin used was a very-high-barrier which has been developed to increase the retention of methyl bromide in the soil. The application rate was 350 pounds per acre of formulated product, 98 percent methyl bromide/2 percent chloropicrin.

The application was to take place during a single day, but due to impending rain forecasts, the decision was made by the applicator to treat as much of the field as possible a day early. An area of approximately 8 acres was treated on the afternoon of the first day, and the additional 11 acres were treated the following day. Ambient air samples were collected at various locations using charcoal tubes and SKC air samplers. All samplers were located at the 24-hour buffer zone distance of 30 feet from the edge of the field with an additional sampler set up during the sampling period between applications. Tables 8 and 9, and Figure 5 indicate the position of each sampler. A series of two sampling periods were monitored at nine locations beginning with start of fumigation at 14:30 for the first day of application. During the second day of application, eight samplers were located around the entire field. The first 3.5-hour sampling period encompassed the application period during the first day, and the third six-hour sampling period encompassed the application period the following day. Monitoring continued through an additional 13-hour period, a 6-hour period and a 12-hour period, for a total of 40.5 hours.

Results for Field 5 — Ambient methyl bromide 24-hour time-weighted average concentrations at the buffer zone distance ranged from 0.26 ppm to 0.99 ppm (Tables 7 and 8, Figure 5). DPR's target level of 0.21 ppm was exceeded at the buffer zone distance (30 feet) during both days of monitoring. Higher concentrations were detected on the second day.

The air temperature during the monitoring period ranged from 41 to 63 degrees Fahrenheit with thin overcast conditions. The wind speeds ranged from 0 to 11 miles per hour, and 5 miles per hour or less 90 percent of the time.

Table 7. Ambient methyl bromide air concentrations during winter months, Field 5, Day 1, shallow, very-high-barrier tarped application.

Sampler Location			Methyl Bromide (ppm) for Each Sampling Period	
			14:30 - 18:00 (3.5 hours)	18:00 - 07:00 (13 hours)
Site ID	Direction	Distance (ft)		
3	southwest	30	0.12	0.59
4	west	30	0.20	0.55
5	northwest	30	ND ^a	0.26
6	north	30	ND	0.26
7	north	30	ND	0.21
8	north	30	ND	0.22
9	northeast	30	0.076	0.18
10	east	30	0.070	0.13
11	southeast	30	0.33	0.14
13	south	30	NA	0.36

^a ND = no detectable amount; reporting limit = 0.017 parts per million

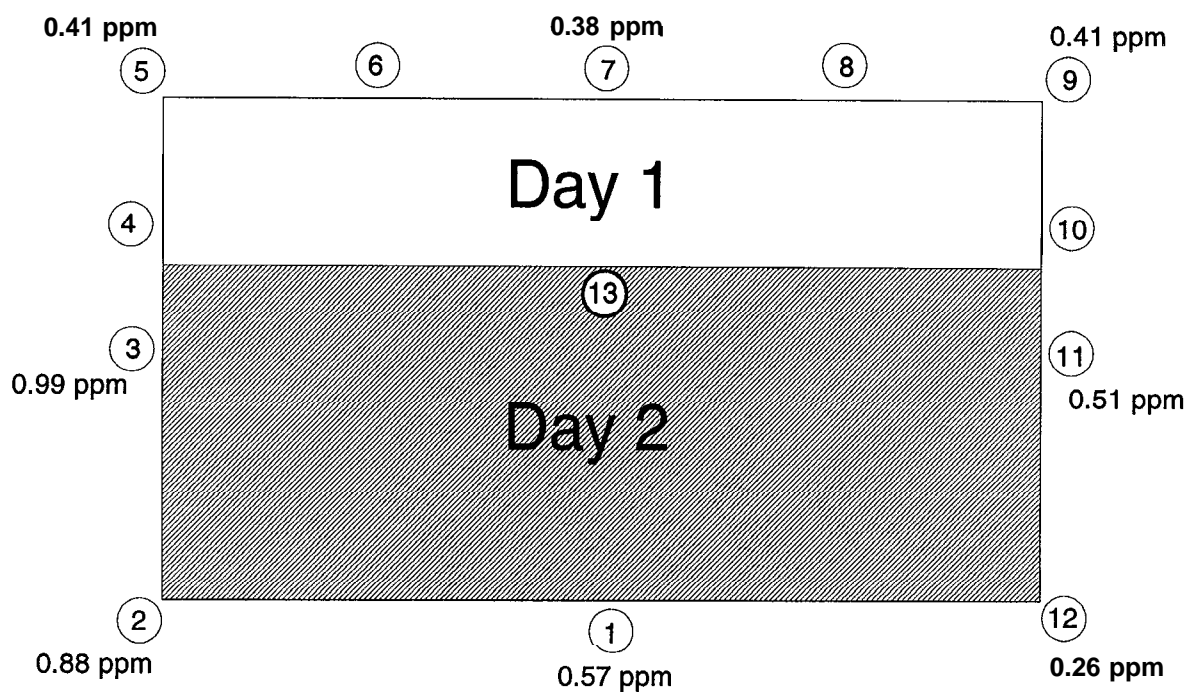
Table 8. Ambient methyl bromide air concentrations during winter months, Field 5, Day 2, shallow, very-high-barrier tarped application.

Sampler Location			Methyl Bromide (ppm) for Each Sampling Period		
			07:00 - 13:00	13:00 - 19:00	19:00 - 07:00
Site ID	Direction	Distance (ft)	(6 hours)	(6 hours)	(12 hours)
1	south	30	0.029	0.45	0.90
2	southwest	30	0.035	0.72	1.4
3	west	30	0.31	1.2	1.2
5	northwest	232	0.22	0.52	0.46
7	north	240	0.23	0.63	0.33
9	northeast	232	0.30*	1.2	0.063
11	east	30	0.22	1.4	0.23
12	southeast	30	0.013	0.27	0.37**

*Sampler ran only 1.7 hours

**Sampler ran only 10 hours

Figure 5. The application site, sampling sites and highest 24-hour time-weighted averages, Field 5, Day 2, shallow, very-high-barrier tarped application.



Materials and Methods for Field 6 — The sixth field monitored during the study was a 10-acre field near Santa Maria (San Luis Obispo County) treated by a tarped shallow injection application on February 13, 1997. This method of application involves the injection of methyl bromide into the soil at a depth between 10 and 15 inches deep and simultaneous coverage with tarp. In this case, the tarpaulin used was a 1.0 mil high barrier material. The application rate was 400 pounds per acre of formulated product, 50 percent methyl bromide/50 percent chloropicrin.

The application started at 6:30 and ended at 10:45. Ambient air samples were collected at various locations using charcoal tubes and SKC air samplers. All samplers were located at the resident buffer zone of 30 feet from the edge of the field. Tables 10 and 11 and Figure 6 indicate the positions of each sampler. The first 6-hour monitoring period encompassed the application period. Monitoring continued through an additional 6-hour period and three 12-hour periods, for a total of 48 hours.

Results for Field 6 — Ambient methyl bromide 24-hour time-weighted average concentrations at the buffer zone distance ranged from 0.006 ppm to 0.082 ppm (Tables 9 and 10, Figure 6). DPR's target level of 0.21 ppm was not exceeded at the buffer zone distance (30 feet) during either day of monitoring. Higher concentrations were detected on the second day.

The weather was cool and clear during the monitoring period. The air temperature during the monitoring period ranged from 37 to 74 degrees Fahrenheit with slightly cloudy skies. The wind speeds ranged from calm to 10 miles per hour, and less than 6 miles per hour 84 percent of the time.

Table 9. Ambient methyl bromide air concentrations during winter months, Field 6, Day 1, shallow tarpaulin application.

				Methyl Bromide (ppm) for Each Sampling Period		
Sampler Location				6:30-12:30	12:30-18:30	18:30-06:30
Site ID	Direction	Distance (ft)		(6 hours)	(6 hours)	(12 hours)
1	south	30		ND"	0.047	0.12
2	southwest	30		ND	0.012	0.055
3	west	30		0.009 1	0.029	0.070
4	northwest	30		ND	0.012	0.032*
5	north	30		ND	0.041	0.070
6	northeast	30		0.0092	0.039	0.046
7	east	30		0.012	0.065	0.07 1
8	southeast	30		ND	0.032	0.085

"ND = no detectable amount; reporting limit = 0.010 parts per million

*Sampler ran only 2.7 hours

Table 10. Ambient methyl bromide air concentrations during winter months, Field 6, Day 2, shallow tarpaulin application.

Sampler Location			Methyl Bromide (ppm) for Each Sampling Period	
			06:30-18:30 (12 hours)	18:30-06:30 (12 hours)
Site ID	Direction	Distance (ft)		
1	south	30	0.045	0.12
2	southwest	30	0.015	not analyzed*
3	west	30	0.014	0.018
4	northwest	30	ND ^a	0.013**
5	north	30	ND	0.029
6	northeast	30	ND	0.010
7	east	30	0.016	0.020
8	southeast	30	0.030	0.062

^aND = no detectable amount; reporting limit = 0.005 parts per million

*Sample not analyzed, sampler ran only 2 minutes

**Sampler ran only 10 hours

Figure 6. The application site, **sampling** sites and highest 24-hour time-weighted averages, Field 6, shallow tarpaulin application.

